

Table of Contents

Chemistry and Origins of Living Systems	1
Invited Speakers	
Could Biochemistry Have Hydrothermal Origins?	3
A Chiroselective Peptide Replicator and its Relevance to Issues Concerning the Origin of Homochirality on Earth	5
Oral Presentations	
Organic Synthesis in Simulated Interstellar Ice Analogs	7
The Origin of Organic Matter in the Solar System: Evidence from Interplanetary Dust Particles	9
Selective Adsorption of L- and D-Amino Acids on Calcite: Implications for the Origin of Biochemical Homochirality	12
Effectiveness of Hydrogen Sulfide as a Reductant in Hydrothermal Systems: Implication for Prebiotic Synthesis of C-H-O-N Compounds	13
The Origins of Evolution	16
Atmospheric Aerosols in Prebiotic Chemistry	18
Poster Presentations	
Stability and Transformations of Nitrogenous Compounds Under Hydrothermal Conditions	19
What is Life?	20
Equilibrium Modeling of Hydrothermal Vent Fluid Cooling and its Application in a Lab-Scaled Reactor	21
BASIC: A New Method for the Isolation of RNA Catalysts	23
Crystallization of a Ni and FeS Protein that Fixes CO ₂ into Cell Carbon	24
Higher Order Models for Detecting Functional Divergence When Analyzing the Evolutionary Past	25
The Genetics of Extraterrestrial Life?	27
Emergence and the Origin of Life	29
Hydrothermal Reactions of Pyruvate: Production of Amphiphilic Molecules and Vesicle Formation	31
Functional Proteins from a Random-Sequence Library	32
Evolutionary Accretion of Small Motifs Modulates RNA Activity	33
Synthesis of Alpha-Amino Acids in Hydrothermal Media from Selected Primitive Starting Compounds	34
Molecular Recognition, Catalysis and the Origin of Life	36
Gene Fusion: A Genome Wide Survey	38
In-Situ Spectroscopic Observation of Abiotic Chemical Reactions Producing Organic Matter	40

Multiple Catalytic Functions of the <i>Escherichia coli</i> Fad B Protein Terminal Region: Anatomy of a Promiscuous Active Site	42
MALDI-MS, HPLC-APCI-MS and Solids NMR Analysis of Hydrogen Cyanide Polymers	43
Molecular Dynamics (MD) Lattice Gas for Modeling Molecular Self-Assembly and Self-Organization Processes	44
Models of Protocellular Structure, Function and Evolution	47
Fate of CO Hydration Products in Anoxic Solution: The Photochemical and Thermal Decomposition of Na Formate	49
Creating a Proto-Organism Through Lowest Entropy Departure Path	51
Evolution of Proteins	53
Expanding the Limits of RNA Catalysis	55
Peptide Formation in Hydrothermal Environments	57
A Chiroselective Peptide Replicator	58
When Can You Attribute Biological Origins to Small Organic Molecules?	60
Alternative Nucleic Acids	61
Evolution of Gene Order in Prokaryotes	62
Experimental Paleobiochemistry: Understanding Major Transitions in Life on Earth	64
De Novo Catalysts of Biopolymer Synthesis	66
Mosaicism in 16S rRNA Genes	67
Current Earth Environments as Analogues for Extraterrestrial Environments	71
Invited Speakers	
Biogeochemical Processes in Microbial Ecosystems	73
Ecogenomics: Ensemble Analysis of Gene Expression in Microbial Communities	75
Oral Presentations	
Sulfur / Carbonate Springs and Life in Glacial Ice	77
Bioinformatics, Organic Chemistry, and Paleontology.	
Building a Comprehensive Model for Recent Life on Earth	80
Methane-Consuming Microbial Consortia Identified and Studied Using a Novel	
Combination of Fluorescent in-situ Hybridization and Ion Microprobe $\delta^{13}\text{C}$ Analysis	82
Composition of Hydrothermal Vent Microbial Communities as Revealed by	
Analyses of Signature Lipids, Stable Carbon Isotopes & Aquificales Cultures	84
Application of Fe Isotopes to the Search for Life and Habitable Planets	86
Pigments and Other Biomolecules in Extreme Antarctic Microbial Habitats:	
Analogues for Evaluating Raman Spectroscopic	
Evidence of Preserved or Relict Life on Mars?	89

Poster Presentations

Iron Geomicrobiology of the Tinto River	91
Imaging and Geochemistry of Black Smoker Chimneys Using Three-Dimensional Synchrotron X-Ray Computed Tomography	92
Hyperthermophilic Microbial Communities in Silica-Depositing Yellowstone Hot Springs Exhibit More Morphological and Sequence Diversity than Previously Detected	94
Flagellate Growth and Survival Under Conditions Potentially Encountered at Deep Sea Hydrothermal Vents	96
Carbonate Biogenic Structures in Storr's Lake, Bahamas	98
Protection Ways Against Extreme Solar Ultraviolet Radiation: A Preliminary Study	101
Molecular Basis of Spectral Tuning in Opsins	102
Evidence of Novel Eukaryotes in Guaymas Basin	
Hydrothermal Vent Sediments: Life at the Extremes	104
Morphological and Metabolic Aspects of Neutrophilic, Lithotrophic Fe-Oxidizing from Deep-Ocean Hydrothermal Vents in the Pacific Ocean	106
Microbes That Follow the Water	107
GEOPULSE: Gene Expression Observations for Planetary Life Study	109
Visible/Near-Infrared and Thermal Infrared Field Spectroscopy Of Modern And Ancient Calcareous Tufa Deposits	111
The Purification and Characterization of Superoxide Dismutase from <i>Chloroflexus aurantiacus</i> and the Effects of UV Radiation on the Activity of SOD and Catalase in Hydrothermal Mats of Yellowstone National Park	114
Detection and Enumeration of Microbial Life in the Perennially Ice Covered Lake of the McMurdo DryValleys	115
Mass-Independent Fractionation of Oxygen Isotopes in Earth's Atmosphere	116
Archaeal and Bacterial Diversity in a Moderately Acidic Thermal Spring	117
Cytosolic pH Maintenance in Eukaryotic Acidophiles	118
Hydrothermal Habitats in Astrobiology	120
Potential Evaporite Biomarkers from the Dead Sea	122
Amino Acid Analyses of Acid Hydrolysates in Desert Varnish	125
Visible-Near Infrared Spectroscopy of Siliceous Sinter, Yellowstone National Park - Search for Organic Signatures	126
Visible-Near Infrared Spectroscopy of Hyperthermophile Organisms, Yellowstone National Park	129
How Cyanobacterial Distributions Reveal Flow and Irradiance	
Conditions of Photosynthetic Biofilm Formation	131
Use of the $\delta^{13}\text{C}$ Associated With Amino Acid Biosynthesis as a Proxy for Examining the Flow of Carbon Through Biological Systems	132
Observations on Microbial Metabolism at Extreme Pressures!	134
Molecular Survey of Microbial Diversity in Hypersaline Ecosystems	135

Determining Biosignatures by Complexity Analysis in Antarctic Cryptoendolithic Communities	136
Deep UV Native Fluorescence Imaging of Antarctic Cryptoendolithic Communities	137
Novel Archaea in Guaymas Basin Hydrothermal Vent Sediments:	
Evidence for Anaerobic Methanotrophy	138
Archaeal Park: A Research Project on Interaction	
Between Sub-Vent Biosphere and Geo-Environment	140
A Structural and Molecular Approach for the Study Biomarkers	142
Photoendolithic Ecosystems: Molecular Diversity and Structure	144
The Changing Geochemical Environment of a Thermal Spring May Provide	
Clues to Environmental Conditions and Microbial Evolution on Mars	145
Eukaryotic Diversity in an Acidic, Metal-Rich Environment: Spain's Tinto River	147
Eukaryotic Diversity in Alkaline Lakes of the Sandhills Region of Nebraska	149
Astrobiology Space Missions: What Will We Find on Mars, Europa...?	151
Invited Speakers	
Exploring for Martian Life: Recent Results and Future Opportunities	153
Europa: Views from the Galileo Mission	155
Oral Presentations	
The Source of Extraterrestrial Water in Martian Meteorites	157
Radiolytic Chemistry at Europa's Doorstep - The First Meter	159
Beagle 2: The Next Exobiology Mission to Mars	160
Europa: Crunchy or Chewy Inside?	163
Magnetofossils in Terrestrial Samples and Martian Meteorite ALH84001	164
Poster Presentations	
Astrobiology Investigations at a Martian Hematite Site	167
Confirmation of Spectrally Interpreted Mineralogy of Badwater Basin, Death Valley, CA: Applications to Identification of	
Evaporite Minerals on the Martian Surface	170
High Resolution Chemical Study of ALH84001	172
Organization of P, S, and Fe Inclusions in a Freshwater Magnetococcus	173
Laboratory Studies of Hydrocarbon Nucleation on Tholin Particles and	
Thin Organic Films: Application to Titan's Atmosphere	175
A New Molecular Recognition Instrument for Astrobiological Applications	176
Astrobiology with ESA Science Missions	178
AFM and XPS Analysis of Fossilized Microorganisms	179
Mars Volatile and Climate History: Relevance to Life	181
Iron Isotope Measurements in Meteorites and Terrestrial Rocks	183

Isotopic Biosignature in Calcite Formed During Weathering of Basalt: Implications for Past Life on Mars, Early Life on Land, and ALH 84001	185
Follow the Water, Beware the Brine: Astrobiological Implications of Aqueous Seeps on Mars	187
Consequences & Artifacts: Terrestrial Findings and Martian Analogues of an Air-Water Interface	189
Isotopic Analysis of High and Low Temperature Components of Tagish Lake: Anatomy of a New, Very Primitive Carbonaceous Chondrite	191
Abiotic Versus Biotic Weathering Of Olivine As Possible Biosignatures	194
Thermal Desorption/GC/MS Analysis of Astrobiologically Relevant Organic Materials	197
Possible Biologic Features in Martian Meteorite Nakhla	198
Volcano-Ice Interactions and the Exploration for Extant Martian Life	201
The Organic Content of the Tagish Lake Meteorite	204
Detecting Organic Molecules on Mars	205
Biotechnology Approaches to Life Detection	206
Application of Computer Tomography for Life Detection	209
Dry Mars: Parched Rocks and Fallen Dust	210
Concomitant Microbial Carbonate Precipitation and Maskelynite Alteration by <i>Archaeoglobus fulgidus</i>	212
Visualization of Microbial Biomarkers by Scanning Electron Microscopy	214
SNC Meteorites, Organic Matter and a New Look at Viking	216
Salts in Martian Meteorites: A Complex Martian History	219
The Evolution of Early Life on Earth: An Analogue for Extraterrestrial Environments	223
Invited Speakers	
Evolutionary Genomics Focus Group	225
Protistan Microfossils in Early Mesoproterozoic Rocks	226
Lithosphere-Hydrosphere Interactions on the Hadean (>4.0 Ga) Earth	228
The Evolution of O ₂ and CO ₂ in the Atmosphere	231
Oral Presentations	
Geochronological Constraints on Early Animal Evolution and the Significance of the Precambrian-Cambrian Boundary	233
Pelobionts: Ancient Eukaryotes or Degenerate Protists?	235
Considerations for Evaluation of Isotopic Evidence for Biological Activity	237
Deep Bilaterian Phylogeny: The Evolution of Adaptation to Extreme Environments	240
Environmental Conditions of the Early Earth at the Time of the Earliest Microfossil Record	242
Glacial Eustasy and the Flux of Iron from Mid-ocean Ridge Hydrothermal Systems	244

Biogeochemistry of the 1640 Ma McArthur River (HYC) Lead-Zinc Ore and Host Sediments, Northern Territory, Australia	246
Carbon Dioxide Cycling and the Climate of Ancient Earth	248
Poster Presentations	
A Model for Evolution of the Seawater Oxygen Isotope Composition	249
Ecophysiological Changes in Microbial Mats	
Incubated in a Greenhouse Collaboratory	251
The Evolutionary Position of Nematodes	253
Detection of Morphological Fossils of Microbial Communities at Life's	
Upper Temperature Limit: An Astrobiological	
Search Strategy for Evidence of Biofilms	254
Biogenic Methane and the Rise of Oxygen	256
Constraints on Early Mantle Redox State	258
How Does <i>C. elegans</i> Respond to Altered Gravity?	259
Late Archean Biomarkers in Carbonates from the	
Hamersley Basin, Pilbara Craton, Western Australia	261
Biotic Recoveries from Mass Extinctions: Insights into Evolutionary Innovation	263
Genes Involved in Photosymbiotic Interactions	265
Modeling the Evolution of Food Webs Under Biogeochemical Constraints	267
A Genomic Timescale for the Origin of Eukaryotes	268
Microbial Mats as Self-Regulating Systems	269
Using Homolog Groups to Create a Whole-Genomic	
Tree of Free-Living Organisms: An Update	270
Towards an Understanding of the Late Archean Sulfur Cycle	272
The Sulfur Isotopic Composition of Neoproterozoic Seawater Sulfate:	
Implications for a Snowball Earth	274
Photochemical Modeling of Mass-Independent Sulfur Isotope	
Fractionation in Low-O ₂ Atmospheres	276
Proterozoic CO ₂ Levels Estimated from in-situ Carbon-Isotopic	
Compositions of Organic-Walled Microfossils	278
NAI Evolutionary Genomics Focus Group Plans for Investigating the	
Metazoan Radiation (Cambrian Explosion) in the Context of the Snowball Earth	280
Constraining Sulfate and Oxygen Availability in the Mesoproterozoic Ocean	282
Geology and Age of Supracrustal Rocks, Akilia Island, Greenland:	
New Evidence for a >3.83 Ga Origin of Life	284
Sedimentary Parameters Controlling Occurrence and Preservation of	
Microbial Mats in Siliciclastic Depositional Systems	286
How Much Did Horizontal Gene Transfer Contribute to Early Evolution?:	
Quantifying Archaeal Genes in Two Bacterial Lineages	287
Dissolution Kinetics of Natural Uraninite and the	
Evolution of Atmospheric Oxygen	289
Hydrocarbon Haze as a Source of Low- ¹³ C Late Archean Kerogens	291

The Anoxygenic Filamentous Phototrophs: (1) Recent Advances in Diversity and Phylogeny (2) The Place of Chloroflexus in High Iron Hot Springs	293
Independent Land Colonization Events by Myriapods and Hexapods	
During the Neoproterozoic	295
Characterization of a Carbonic Anhydrase from an Obligately Chemolithoautotrophic Thermophilic Archaeon	296
Molecular Evolution Analysis of Photosynthesis	297
Geochemical and Isotopic Investigation of Paleozoic Paleosols Formed Under Varying Redox Conditions	298
Archean Sulfates from Western Australia: Implications for Earth's Early Atmosphere and Ocean	301
Neodymium Isotope Investigation of a Precambrian Weathering Profile: Hokkalampi Paleosol, North Karelia, Eastern Finland	303
Shallow to Deep Water Transitions on Early Archean Subsiding Platforms, Barberton Greenstone Belt, South Africa	305
The Combined Detection of Morphological and Molecular Biomarkers: Implications for Astrobiology	306
Earth's Orbital History Revisited	308
Development of Cyanobacterial Mats on Soil Surface Under an Oxygenated Atmosphere 2.6 Gya Ago at Schagen, Eastern Transvaal, South Africa	309
Organic Carbon, S, Mo, U, and V in the Archean and Paleoproterozoic Black Shales	311
Maximum Likelihood Mapping as Tool for Comparative Genome Analyses	313
Astrobiology Space Missions: What Will We Find Outside Our Solar System?	317
Invited Speakers	
Extrasolar Planets	319
Oral Presentations	
Stratospheric Observatory for Infrared Astronomy (SOFIA)	320
Prospects for the Detection of Earths Orbiting Other Stars	321
Large and Complex Organics in Space	322
Eddington: A European Mission to Search for Earth-Like Habitable Planets	323
Planetary Formation: Fast or Rare?	324
Poster Presentations	
Gas Giant Protoplanet Formation: Rapid or Slow?	327
On the Threshold of Inorganic Life	329
Shock Chemistry in the Inner Solar Nebula	331
Volcanically Induced Climate Change on CO ₂ -Dominanted Terrestrial Planets	333
Searches for Planets and Brown Dwarfs	335

Numerical Modeling of Solar System Dust Environments	336
The Runaway Greenhouse Effect on Earth and other Planets	337
Detecting and Identifying Organic Molecules in Space -	
The AstroBiology Explorer (ABE) MIDEX Mission Concept	339
Identifying Young, Nearby Stars	340
A New Approach to Planet and Asteroid Formation	341
Supergreenhouse Molecules and the Limits of the Habitable Zone	343
Education and Public Outreach	345
Building Community in Astrobiology Through Education and Public Outreach	347
Connect with Education and Public Outreach on Your Team	348
Astrobiology Education and Outreach at Penn State	349
Astrobiology at Arizona State University: Program Overview and	
Research/Outreach Highlights	351
SPACELINE, a Bibliographic Database for Astrobiology: Capabilities and Issues	353
An Astrobiology Microbes Exhibit and Education Module	355
Fly Me to the Moon: A System for Technologically Enhanced Outreach	357
micro*scope and Biose-IT - Web Based Resources for	
Promoting Awareness of Microbial Biodiversity	358
Bacterial Paleontology as a Course of the Lectures for the	
Students- Geologist and Paleontologist of Moscow University	360